Surgical Pearls and Pitfalls for Effective and Reproducible Arthroscopic Rotator Cuff Repair

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Abstract: Arthroscopic rotator cuff repair is a common orthopedic procedure. This can be a technically challenging and frustrating procedure without adherence to basic principles and guidelines. The authors aim to present a concise treatment strategy for preoperative evaluation, surgical intervention, and postoperative care to achieve secure, anatomic, and reproducible repairs. [Orthopedics. 2014; 37(7):472-476.]

Rotator cuff disease is a common cause of shoulder pain, particularly in patients older than 40 years, and accounts for up to 4.5 million physician visits and 75,000 surgical procedures annually. Rotator cuff tears occur in approximately 30% of the asymptomatic population. Multiple studies have demonstrated an increasing incidence of rotator cuff tears with advancing age. In a cadaveric study, Lehman et al found a 17% incidence of full-thickness rotator cuff tears overall and an incidence as high as 30% for specimens older than 60 years. Ultrasound, magnetic resonance imaging (MRI), and arthrography have all been used to study and detect rotator cuff tears in asymptomatic patients and have found full-thickness tears in 4% to 13% of individuals between 40 and 60 years old, 20% of individuals between 60 and 70 years old, 31% to 50% of individuals between 70 and 80 years old, and 50% to 80% of individuals older than 80 years.

The advancement of arthroscopic technology, equipment, and instrumentation has made arthroscopic rotator cuff repair an effective strategy for the treatment of symptomatic rotator cuff tears. Results are essentially equivalent to those with mini-open techniques, with 85% to 95% of patients having improved pain and functional outcomes.

The proposed added benefits of arthroscopic repair include improved visualization of tear patterns and associated intra-articular pathology, smaller skin incisions with less soft tissue and deltoid dissection, and a lower risk of infection.

The authors present their strategy and technique along with pearls and potential pitfalls for safe, effective, secure, and reproducible arthroscopic rotator cuff repair. A methodical approach to patient evaluation, surgical treatment, and postoperative care lays the groundwork for a successful outcome.

Preoperative Evaluation
As with all patient encounters, an accurate history and thorough physical examination are paramount. The differential diagnosis of shoulder pain includes, but is not limited to, cervical spine disease, arthritic conditions about the shoulder girdle, rotator cuff disease, long head of the biceps tendon pathology, and glenohumeral instability. Historical elements such as age, chronicity, occupation, and previous treatment along with a complete physical examination of the cervical spine and shoulder girdle assist in establishing the diagnosis and determining testing and treatment.

Routine imaging consists of plain radiographs of the shoulder, including true anteroposterior, axillary, and outlet views. With the anteroposterior radiograph, attention is focused on sclerosis or cystic changes on the humeral tuberosities as well as maintenance of Shenton’s line, indicating an absence of anterosuperior humeral head escape associated with chronic irreparable posterosuperior rotator cuff tear.

Magnetic resonance imaging is invaluable for evaluating tear size, number of tendons involved, tear thickness, presence of retraction, and the overall 3-dimensional character of the rotator cuff tear. Magnetic resonance imaging also can be

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used to evaluate the quality of the rotator cuff muscle and the presence of muscle atrophy and fatty infiltration. Goutallier et al\(^9\) proposed a computed tomography classification of tears based on fatty infiltration of the rotator cuff musculature with prognostic significance. Fatty infiltration greater than muscle volume is associated with increased rates of repair failure.

Patient factors beyond the surgeon’s control, including advanced age, gender, smoking, tear size, worker’s compensation status, and lowered patient expectations, have been associated with poor outcomes following rotator cuff repair.\(^{10-18}\)

Preoperative discussion, including counseling regarding potential risk factors for complications or failure, and shared decision-making with the patient should focus on laying the groundwork for managing expectations postoperatively.

**Arthroscopic Rotator Cuff Repair Technique**

Although arthroscopic rotator cuff repair can be performed effectively in the lateral decubitus position, the authors prefer a modified beach chair position (Figure 1) using a commercial bed attachment (Tenet T-Max shoulder positioner; Smith & Nephew, Andover, Massachusetts) with the arm prepped free with wide access to the shoulder, including the coracoid, acromioclavicular joint, and posterior scapula. This position offers the advantage of flexibility in arm positioning throughout surgery as well as easy conversion for open procedures if needed. The cervical spine should be neutrally aligned in a padded head holder, with the nonoperative arm placed in a padded holder and a foam wedge placed under the patient’s legs to prevent inferior migration of the patient’s body during the procedure. Cerebral and spinal cord hypoperfusion have been reported with the sitting position,\(^{19}\) mandating communication with the anesthesia team regarding safe blood pressure maintenance. Arthroscopic fluid management using a pump with low pressure settings, typically 30 to 40 mm Hg, along with epinephrine in the fluid allows for excellent visualization throughout the procedure while minimizing the effects of swelling, which can prove detrimental to visualization. In shoulder surgery, use of dilute epinephrine in the arthroscopic irrigant has been shown to improve the visual field without increasing the risk of cardiovascular side effects.\(^{20}\)

Accurate topographic markings of the scapular spine, acromion, distal clavicle, and coracoid are essential for safe and effective portal placement (Figure 2). The authors begin by establishing a standard posterior glenohumeral portal for viewing and then creating an anterior working portal through the rotator interval from outside-in with spinal needle guidance. A full diagnostic inventory of the glenohumeral joint is undertaken with a 30° arthroscope to assess both the rotator cuff and other articular pathology. Articular work such as labral debridement and release of the long head of the biceps tendon from its insertion on the superior labrum may be performed at this time. The long head of the biceps should be tenotomized and tagged with suture if it displays signs of tendinosis, synovitis, or instability. Several methods of arthroscopic or open biceps tenodesis have

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**Figure 1:** Modified beach chair positioning for right shoulder arthroscopic rotator cuff repair. The acromion is roughly positioned parallel to the floor.

**Figure 2:** Topographic markings and portal placement for right shoulder rotator cuff repair. Abbreviations: A, posterior portal; B, midlateral acromial portal; C, anterolateral acromial portal; D, anterior portal.
Arthroscopic subacromial bursoscopy. The bursa is swept anterior acromion and the trocar cannula from the posterior portal. A midlateral acromial portal is established as a working portal during repair. Bleeding is likewise minimized with relative hypotensive anesthesia. Given the effects of the Bernoulli principle, bleeding can be decreased by decreased fluid turbulence due to egress of fluid from portal sites. The bursa is fully debrided to visualize the entire subacromial space, being careful not to violate the deltoid fascia superiorly or the rotator cuff inferiorly. Although debatable, the authors do not routinely release the coracoacromial ligament or perform a bony acromioplasty in the absence of a large acromial enthesophyte because they prefer to maintain the coracoacromial arch, particularly in the presence of large tears. Large bone spurs are smoothly contoured with an arthroscopic shaver device. Typically there is adequate visualization and working space to perform rotator cuff repair without acromioplasty.

The arthroscope is next switched to the mid acromial portal for a “50 yard line” view of the rotator cuff insertion on the greater tuberosity and for a view of the full extent and morphology of the tear (Figure 3). Multiple tear patterns of the posterosuperior rotator cuff have been described, with crescent, “U”-shaped, “L”-shaped, reverse “L”-shaped, and massive contracted tears being common. Assessment of the tear pattern and mobility of the tear in both the medial to lateral and the anterior to posterior directions is critical in planning possible releases as well as suture and anchor placement to anatomically and securely reduce the tear to the greater tuberosity. Use of an arthroscopic soft tissue grasping forceps is recommended to assess tear mobility and reducibility. For contracted tears, a blunt elevator or liberator can be used to perform bursal adhesion releases superior to the rotator cuff in the subacromial space and capsular adhesion releases inferior to the rotator cuff in the glenohumeral joint. Care should be taken to avoid overly aggressive releases greater than 2 cm medial to the glenoid to prevent supraspinular nerve injury. Interval slide releases can be used to increase tendon excursion in massive contracted tears. The use of side to side margin convergence type sutures is routine for large U-shaped and L-shaped tear variations to restore an anatomic reduction of the rotator cuff tendon.

An anterolateral acromial portal is established as a working portal for anchor placement, suture placement, and arthroscopic knot tying. An 8-mm threaded plastic cannula is placed in this portal. The portal is placed just off the bony edge of the anterolateral acromion using a spinal needle for guidance. This portal offers an excellent approach for anchor placement for most supraspinatus and infraspinatus tears. With the use of arm rotation, multiple anchors can be effectively placed through this portal. An accessory posterosilateral acromial portal can also be created for additional posterior anchor placement and suture storage. Preparation of the tear footprint on the greater tuberosity is performed with a radiofrequency ablation device followed by a shaver to lightly decorticate
the surface without excessive bone removal. A microfracture awl can be used to create small channels in the tuberosity to help promote a bleeding bone bed at the repair site.

Repair begins with side to side free suture passage and tying to re-approximate L- and large U-shaped tears (Figure 4). Arthroscopic knot tying with attention to both loop and knot security is an essential skill for this step. Multiple arthroscopic sliding and non-sliding knots have been described. Proficiency with one sliding and one non-sliding knot is required. In general, anchor and suture placement is dictated by tear pattern. Anchors are next placed through the anterolateral portal at the so-called “deadman’s” angle of approximately 45° to the surface of the greater tuberosity to maximize resistance to pullout failure. The process of suture management begins with anchor placement. Organized, thoughtful suture management at the onset will help avoid frustration later in the procedure. Many double- and triple-loaded anchor systems use sutures of differing colors to aid with suture identification. Only a single suture is passed through tissue at a time. Sutures not being passed through the tissue are shuttled and stored as paired ends through either the anterior, the posterior, or an accessory posterolateral portal. Care should be taken with suture manipulation to avoid anchor unloading. The use of tagging hemostats on suture anchor unloading. The use of suture manipulation to avoid tangling. Sutures are typically sequentially placed and later tied from anterior to posterior or posterior to anterior based on tear configuration. The debate regarding single vs double row repairs is beyond the scope of this article. The authors believe that certain tears are best treated with double row repair. These are generally large or massive U-shaped tears that require multiple anchors and are not amenable to margin convergence. In the authors’ hands, large tears are repaired with adjunctive margin convergence and small tears are repaired with a single row construct. In small tears, a Mason-Allen type suture configuration can be used for increased tear security. With adherence to the above technical steps, anatomic and secure repairs are consistently achieved (Figure 5).

**POSTOPERATIVE MANAGEMENT**

Multiple rehabilitation regimens have been advocated. At the authors’ institution, patients are placed in a sling with an abduction pillow that is typically worn for 4 weeks. Most patients receive an interscalene nerve block and are discharged home the day of surgery. Physical therapy is typically instituted approximately 1 week postoperatively, with early emphasis on passive range of motion and scapular awareness exercises. Rehabilitation protocols are tailored to the repair based on tear size and tissue quality. In larger tears with poor tissue quality, therapy is delayed and the repair is protected with sling use for 6 weeks. Strengthening is delayed until 6 weeks postoperatively. Progressive rotator cuff repair, scapulothoracic, and core strengthening are continued approximately 2 to 5 months postoperatively, with reintroduction to athletics and work activities thereafter.

**CONCLUSION**

Re-tear rates for all arthroscopic techniques have ranged from 30% to 90%, with higher re-tear rates for older patients and larger tear patterns. Adherence to a methodological approach will allow for reproducible, anatomic, secure rotator cuff repairs. Surgical success begins with appropriate preoperative evaluation and counseling regarding patient expectations. This is followed by execution of precise surgical technique and then a rehabilitation regimen that provides an appropriate environment for healing and return to function.

**REFERENCES**


